

## CLAIMS

What is claimed is:

- 1 1. A method of applying steerable filter to Laplacian images of a steerable  
2 pyramid, comprising:  
3 getting a Laplacian image from corresponding Gaussian images in a  
4 steerable  
5 pyramid;  
6 verifying the Laplacian image for negative value;  
7 adjusting the Laplacian image to eliminate the negative value;  
8 applying a steerable filter to the adjusted Laplacian image to generate  
9 orientation data and energy data ; and  
10 removing resulting adjustment
- 1 2. The method of claim 1 further comprising generating image descriptors  
2 from the orientation data and the energy data.
- 1 3. The method of claim 1 wherein getting the Laplacian image comprises  
2 subtracting the two neighboring Gaussian images.
- 1 4. The method of claim 1 wherein verifying comprises measuring intensity  
2 value of the Laplacian image.
- 1 5. The method of claim 1 wherein adjusting comprises adding a constant  
2 factor to the Laplacian image such that when the steerable filter is

3 applied to the adjusted Laplacian image, the resulting orientation map  
4 and energy map are not negative.

1 6. The method of claim 1 wherein removing resulting adjustment comprises  
2 compensating for a spatial shift to the energy data, the spatial shift  
3 resulting from the adjustment added to the Laplacian image.

1 7. A method of filtering images, comprising:  
2 constructing a plurality of orientation maps and a plurality of energy  
3 maps from input images, the input images adjusted by a factor  
4 prior to applying filters, the adjustment factor being such that  
5 the plurality of orientation maps and the plurality of energy  
6 maps are non-negative; and  
7 removing resulting adjustment factors from the plurality of energy  
8 maps.

1 8. The method of claim 7 wherein the input images are Laplacian images,  
2 the Laplacian images constructed by subtracting two corresponding  
3 Gaussian images in a steerable pyramid.

1 9. The method of claim 7 wherein the filters are steerable filters.

1 10. The method of claim 7 wherein the adjustment is made to the intensity  
2 value of the Laplacian images.

1 11. The method of claim 7 further comprising constructing image descriptors  
2 for the Laplacian images, the image descriptors constructed from the

corresponding orientation maps and energy maps, the energy maps  
having had the corresponding resulting adjustment factors compensated.

12. In a steerable pyramid, a method of adjusting images prior to filtering,  
comprising:

Filtering an input image at a first time to produce a corresponding  
orientation

map and a corresponding energy map;

Adjusting the input image by an adjustment factor if the orientation  
map

and / or the energy map is negative, the adjustment factor  
being such that when the adjusted input image is filtered, the  
orientation map

and / or the energy map is non-negative; and

Filtering the adjusted input image at a second time.

13. The method of claim 12, wherein the filtering is done by applying  
steerable filters and wherein the input image is a Laplacian image in a  
steerable pyramid.

14. The method of claim 12, wherein adjusting the input image by an  
adjustment factor comprises determining the value of the Laplacian  
image, and adding the adjustment factor such that the value of the  
Laplacian image is non-negative.

15. The method of claim 12 wherein the intensity value is the value of the  
Laplacian image.

1 16. A computer readable medium containing executable instructions which,  
2 when executed in a processing system, causes the system to perform the  
3 steps for filtering images, comprising:  
4 getting a Laplacian image from corresponding Gaussian images in a  
5 steerable  
6 pyramid;  
7 verifying the Laplacian image for negative value;  
8 adjusting the Laplacian image to eliminate the negative value;  
9 applying a steerable filter to the adjusted Laplacian image to generate  
10 orientation data and energy data ; and  
11 removing resulting adjustment.

1 17. The computer readable medium of claim 16 further comprising  
2 generating image descriptors from the orientation data and the energy  
3 data.

1 18. The computer readable medium of claim 16, wherein getting the  
2 Laplacian image comprises subtracting the two neighboring Gaussian  
3 images.

1 19. The computer readable medium of claim 16, wherein verifying comprises  
2 measuring intensity value of the Laplacian image.

1 20. The computer readable medium of claim 16, wherein adjusting comprises  
2 adding a constant factor to the Laplacian image such that when the

3 steerable filter is applied to the adjusted Laplacian image, the resulting  
4 orientation map and energy map are not negative.

1 21. The computer readable medium of claim 16, wherein removing resulting  
2 adjustment comprises compensating the resulting adjustment factor from  
3 the energy map, the resulting adjustment factor corresponding to the  
4 adjustment added to the Laplacian image.

1 22. An apparatus, comprising:  
2 means for filtering input images to produce corresponding  
3 orientation maps  
4 and energy maps; and  
5 means for adjusting the input images such that the corresponding  
6 orientation maps and / or energy maps are non-negative.

1 23. The apparatus of claim 22, wherein means for filtering input images  
2 comprises means for generating Gaussian images from an original image  
3 and means for generating Laplacian images from the Gaussian images,  
4 and wherein steerable filters are used in filtering the Laplacian images.

1 24. The apparatus of claim 22, wherein means for adjusting the input images  
2 comprises means for calculating intensity value of the Laplacian images  
3 and means for adding an adjustment factor to the Laplacian images such  
4 that the intensity value is non-negative.

1 25. A method comprising:

2 filtering input images to produce corresponding orientation maps and

3 energy maps; and

4 adjusting the input images such that the corresponding orientation maps

5 and / or energy maps are non-negative.

1 26. The method of claim 25, wherein filtering input images comprises:

2 generating Gaussian images from an original image;

3 generating Laplacian images from the Gaussian images; and

4 filtering the Laplacian images by using steerable filters.

1 27. The method of claim 25, wherein adjusting the input images comprises:

2 calculating intensity value of the Laplacian images; and

3 adding an adjustment factor to the Laplacian images such that the

4 intensity value is non-negative.

1 28. A computer system comprising:

2 a processor; and

3 an image processing logic coupled to the processor, comprising

4 generation logic to form Gaussian images from an original

5 image and to form a Laplacian image from the

6 corresponding two Gaussian images,

7 adjustment logic to add a value to the Laplacian image such

8 that the Laplacian image is non-negative, and

9 logic to apply a steerable filter to the adjusted Laplacian image

10 to produce an energy map and an orientation map.

1 29. The computer system of claim 28 further comprising logic to compensate  
2 for partial shift to the energy map, the partial shift resulting from the  
3 corresponding adjustment made to the Laplacian image.

1 30. The computer system of claim 28 wherein the Gaussian images and the  
2 Laplacian images are in a steerable pyramid, and wherein the value of  
3 the Laplacian image is measured by its intensity.

1 31. The computer system of claim 28 further comprising logic to form image  
2 descriptors using the orientation map and the energy map.